DOCUMENT RESUME

ED 404 826 EC 305 347

AUTHOR	Chang, Moon K.; And Others
TITLE	Accommodating Students with Disabilities: A Guide for School Teachers.
INSTITUTION	Alabama State Univ., Montgomery. Coll. of Education.; Alabama Univ., Birmingham. Coll. of Medicine.
SPONS AGENCY	National Inst. on Disability and Rehabilitation Research (ED/OSERS), Washington, DC.
PUB DATE	96
CONTRACT	N133B30025-95A
NOTE	41p.; For a related document, see EC 305 348.
PUB TYPE	Guides - Non-Classroom Use (055)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	*Access to Education; *Assistive Devices (for Disabled); *Classroom Techniques; Communication Aids (for Disabled); *Disabilities; Elementary Secondary Education; Hearing Impairments; Learning Disabilities; Media Adaptation; Physical Disabilities; Visual Impairments
IDENTIFIERS	*Academic Accommmodations (Disabilities); Testing Accommodations (Disabilities)

ABSTRACT

This guide is designed as a resource to assist teachers in making decisions on their instructional planning and delivery by expanding and refining their repertoire of ways and means of making accommodations for students with learning disabilities and visual, hearing, and physical impairments. Part 1 presents ways of providing accommodations without specialized materials and devices for students with different types of disabilities. These include facilitating lip reading, providing lecture notes, providing tactile materials, and teaching in an accessible classroom. Testing accommodations for students with disabilities are also addressed. Certain ways are used exclusively with certain types of disabilities; however, other types of accommodations can be used across the categories of disabilities. Part 2 lists some of the important materials and devices that are not readily available to teachers for their classes but have high impact on accommodation, such as amplification systems, screen enlargers, Braille word processing, and computer voice input utilities. Short descriptions of these materials and devices are presented. Personal computer access problems and modifications to make the computer accessible to students with disabilities are also discussed. (Contains 40 references.) (CR)

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ED 404 826

Accommodating Students with Disabilities

A GUIDE FOR SCHOOL TEACHERS

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EC305347

This project was funded through a supplemental award by the U.S. Department of Education, National Institute on Disability and Rehabilitation Research Number N133B30025-95A.

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SECTION 504 OF THE REHABILITATION ACT OF 1973, AMERICANS WITH DISABILITIES ACT OF 1990, AND INDIVIDUALS WITH DISABILITIES EDUCATION ACT OF 1990

- Section 504 of the Rehabilitation Act of 1973 grants the right to be free from discrimination to a diverse array of people. Section 504 applies to all individuals including the school-age population. This coverage was increased with the 1990 passage of the Americans with Disabilities Act (ADA). The ADA extends civil rights protection to persons with disabilities in private sector employment, all public services, public accommodation, transportation, and telecommunication. The Education for All Handicapped Children Act (EAHCA), as amended and renamed the Individuals with Disabilities Education Act (IDEA), compliments Section 504. Together, these two acts, Section 504 and IDEA, form the anchor that secures educational rights for children with disabilities.

- Section 504 and ADA require every recipient of federal funds to provide reasonable accommodations to individuals with disabilities. Although the state is not required to lower its graduation requirements to accommodate students with disabilities, nonsubstantive accommodations—particularly in program delivery, such as testing modifications, scheduling modifications, and additional time for tasks—are required when necessary to provide an education for students with disabilities. Section 504 and ADA also require provision of auxiliary aids for students with disabilities. This requirement does not mean that schools, colleges, and employers must have all such aids available at all times; it simply demands that no person with disabilities may be excluded from a program because of the lack of an appropriate aid.

SOURCE. Heward, W. (1996). *Exceptional children: An introduction to special education* (5th ed.). Columbus, OH: Merrill/Prentice-Hall; Turnbull, A., Turnbull, H., Shank, M., & Leal, D. (1995). *Exceptional lives: Special Education in today's schools*. Columbus, OH: Merrill/Prentice-Hall; Underwood, J., & Mead, J. (1995). *Legal aspects of special education and pupil services*. Needham Heights, MA: Allyn & Bacon.

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INTRODUCTION

ACCOMMODATING STUDENTS WITH DISABILITIES: A GUIDE FOR SCHOOL TEACHERS is part of Project AIM (Alternative Instructional Methods), a project funded through a supplemental award by the U.S. Department of Education, National Institute on Disability and Rehabilitation Research.

The project has three major objectives:

- To identify effective ways and means of accommodations that can be used for students with disabilities;
- To synthesize the findings in the form of non-theoretical summaries; and
- To deliver this information directly to school teachers.

This document presents the results of an extensive literature search on ways and means of providing reasonable accommodations under the Americans with Disabilities Act of 1990 for students with visual impairments, hearing impairments, physical impairments, and learning disabilities

The information contained in this publication is designed as a resource to assist school teachers in making decisions on their instructional planning and delivery by expanding and refining their repertoire of ways and means of making accommodations for their students with disabilities. Sometimes common sense is not sufficient to make good decisions to better serve students with disabilities; a certain amount of information about the particular needs of a very heterogeneous group of students is needed in order to provide both physical and programmatic access.

The first part of this publication (PART I) will present ways and means of accommodation without specialized materials and devices. Certain ways and means are used exclusively with certain types of disabilities; however, other types of ways and means of accommodations will be used across the categories of disabilities.

The second part of this publication (PART II) will list some of the important materials and devices that are not readily available to school teachers for their classes but have high impact on ways and means of accommodation. Short descriptions of these materials and devices will be presented.

In order to facilitate reading of the text, citations were eliminated from the body of the text. However, references used for this publication are appended at the end of this publication for those who want further information on certain topics.

PART I: WAYS AND MEANS OF ACCOMMODATIONS WITHOUT SPECIALIZED MATERIALS AND DEVICES

There are certain ways and means that school teachers can use in order to provide accommodations to their students with disabilities. Many of these accommodations can be made with no specialized materials or devices.

Please remember that

- Communication is obviously the major problem to those who have hearing impairments. Hearing impairments may cause students not to hear or comprehend rapidly spoken information, such as procedural instructions, descriptive background, or questions posed by other students and answers given before the actual test begins.

- Visual impairments may cause students not to see or comprehend written material which may include announcement of test dates, procedural information, and content of the examination itself.

- Access is one of the major concerns of students with physical impairments. Students must be able to find accessible routes from the parking lots to classes and offices. It may involve limitations in performing certain acts such as reaching and entering the exam site, sitting for long periods of time, and manipulating test materials.

- Academic problems of students with learning disabilities may be seen in listening comprehension, reading, writing, or mathematics. Problems in nonacademic areas, such as lack of organization, impulsive decision making, lack of metacognition, lack of social-emotional control, can make academic life even more frustrating.

A. ACCOMMODATIONS TO BE USED IN THE TEACHING AND LEARNING PROCESS

The following guidelines should be useful in accommodating students with disabilities.

HEARING IMPAIRMENTS

The two major ways that students with hearing impairments communicate are oral (speech or reading) and manual (sign language). Speech reading is understanding of spoken language by watching lip movements of speakers and sign language is translation of oral communication into manual communication by an interpreter. Persons who communicate in the oral method use a combination of speech and speech reading.

Students who communicate using the manual method use the American Sign Language (ASL) system. This is a system of hand and arm movements, positions, and gestures that translates the spoken word into visual representations. ASL is a short-cut version and is not equal to the English language. Finger spelling may be used in place of the signs in case there are no equivalent signs for the words. This frequently happens when technical or subject-specific vocabulary are used.

Use of Speech (Lip) Reading

Certainly, speech (lip) reading (*see the definition above*) is one solution for some students with hearing impairments. However, the problem is that students who rely on reading lips can at best read 30 percent of the sounds of spoken English. Teachers can help the situation by:

- facing the student directly when speaking.
- speaking normally and naturally rather than exaggerating the lip movement when speaking.
- speaking clearly and concisely.

- speaking at a normal speed rather than speaking too fast.
- avoiding as much as possible talking as you write on the board with your back to the student.

Use of Sign Language

Sign language is another form of communication often used by students with a profound hearing loss. However, it is very difficult, if not impossible, to take notes while watching an interpreter and reading the lips of a teacher. Teachers can help the situation by:

- providing lecture notes to the student.
- making arrangements with a student in the class who takes good notes and who is willing to help the student with hearing impairments by making a copy of the class notes.
- allowing the student with hearing impairments to videotape the lecture.

When students with hearing impairments are using lip reading and sign language, teachers should avoid as much as possible, blocking the area around their mouths with their hands or other objects while talking.

Use of Written Communication

- Listing major topics of the lesson or discussion on the board or overhead projector is a good idea. Especially, use of an overhead projector enables teachers to continue facing students while talking and presenting materials.

- Write on a piece of paper or on the board when it is necessary to communicate with students with hearing impairments.

- Consider using visuals such as charts and graphs.

- If movies without captions are shown, written summaries or outlines of the movies are most helpful.

- Verbal assignments and due dates, exam dates, and changes of normal class schedule may be missed by students with hearing impairments. Written instructions should be given.

Seating

- Select a seat that gives the student a direct line of vision to the teacher and the board or screen.

Lighting

- Providing a good lighting is a must. Students with hearing impairments not only watch lip movements but also facial expressions, gestures, and other body language to communicate. Do not stand in front of a major light source such as windows. Shadows on the face make speech reading difficult.

Use of Nonverbal Language

- Appropriate use of facial expressions, gestures, and other body language is helpful in conveying the message.

Hearing Aid

- A hearing aid is virtually ineffective if the speaker is more than 3 to 8 feet from the hearing aid receiver. Furthermore, in many situations, persons with hearing impairments, even with an appropriate hearing aid, may have difficulty in understanding speech due to competing background noise. For teachers, shortening the distance between the speaker and the listener and minimizing background noise as much as possible are much more effective than raising the voice. Never shout at hard of hearing persons who use hearing aids. They are sensitive to loudness and background noises. Noises are amplified by the hearing aid and interfere with communication with hard of hearing persons.

STUDENTS WITH VISUAL IMPAIRMENTS

There are certain accommodations teachers can use in order to help their students with visual impairments in the classroom. Here are some examples:

Oral Communication

- Students with visual impairments depend almost exclusively on their hearing. Say what is being written on the board. Describe everything that is important to see. Instead of saying, this plus that equals this, one should say 1 plus 2 equals 3. New terms must be spelled.

Tactile Materials

- Try to find ways for students with visual impairments to touch instead of look at things, such as tactile charts and diagrams, if available.

Keeping Students Informed

- Students with visual impairments need to be shown and told about the new locations if furniture and equipment had to be moved around in the classroom or lab.

Seating

- Partially sighted students should sit as close to the front of the class as possible to make maximum use of residual vision and auditory cues.

STUDENTS WITH PHYSICAL IMPAIRMENTS

- There are certain accommodations teachers can use in order to help their students with physical impairments in the class. Here are some examples:

- If a particular classroom is inaccessible, find an accessible location.

- If a class involves field work or field trips, invite students with physical disabilities to take part in the selection of visitation sites or modes of transportation.

- Classes taught in laboratory settings may need to be modified. It is possible to make more room by rearranging furniture and equipment.

- Arrange seating so that students with physical disabilities will have the needed work space.

LEARNING DISABILITIES

There are certain accommodations teachers can use in order to help their students with learning disabilities in the class. Here are some examples:

- Providing computer assisted software to supplement course work, if available.

- Making required book lists available prior to the first day of class to allow students to begin their reading early or to have texts put on tape.

- Providing students with chapter outlines or study guides that cue them to key points in their readings.

- Spelling out course expectations clearly before the course begins (materials to be covered, grading procedures, due dates, etc.).

- Meeting the student individually on a regular basis to clarify concepts and discuss class progress.

- Consider allowing students to complete in-class assignments outside of class.

- Consider alternative or supplementary assignments that may serve evaluation purposes, such as taped interviews, slide presentations, photographic essays or hand-made models.

- Encouraging students to develop note-taking skills even if they are not actively taking notes in the class.

Presentation Methods

- Outlining class presentations by highlighting major concepts and terminology orally and visually--e.g., write and read aloud new terms, key points, and names on the board.

- Repeating and summarizing each segment of the presentation and again reviewing it in its entirety.

- Paraphrasing abstract concepts in specific terms and illustrating them with concrete examples such as models and visual structures (e.g., charts and graphs).

- Highlighting texts using color codes or supplementary symbols.

- Reading aloud material that is written on the board or that is given in handouts or transparencies.

- Keeping oral instructions concise and reinforcing them with brief cue words.

- Repeating or re-wording complicated directions when simplified directions cannot be given.

Study Aids

- Allowing students to use a dictionary, computer spell checks, a proofreader or a calculator in math and science. In math, students may understand the concept, but make errors by mis-aligning numbers or confusing arithmetical facts.

- Allowing students to use a reader, scribe, note taker, word processor, tape recorder or typewriter.

- Making class notes or written outlines of the lesson available.

- Assisting students, if necessary, in arranging to borrow classmates' notes.

B. ACCOMMODATIONS TO BE USED IN TESTING SITUATIONS

The intention of modifications in a testing situation is not to give a competitive edge to students with disabilities but to eliminate their competitive disadvantage by minimizing the impact of their disability on their performance. Reasonableness, mutually agreeable procedures, shared responsibilities, and institutional policies are all important in making adaptations for evaluation. Unless absolutely necessary, students should be allowed to take an adapted test in the same classroom at the same time with the other students. If the adaptation requires the exam to be administered in a place other than the regular exam site, efforts should be made to provide a setting which is equally conducive to concentration. Such a setting should be free from interruptions and distractions.

Types of Test Accommodations

Types of test accommodations may include extended time, reader services, scribe services, oral examinations instead of written examinations, use of calculators, and use of adaptive equipment.

EXTENDED TIME. By providing the extra time necessary to compensate for the disability, teachers ensure that students with disabilities have an opportunity to show content mastery.

- This can be time-and-half, double-time, triple-time or more.
- The needed time varies with the constraints of the specific disability.
- The needed time varies with the type of subject matter.
- The needed time varies with the type of test.

READER SERVICES. A reader assists with reading information or transferring information to the test paper.

- Use of a human reader.
- Alternative: Use of tape readings of the test material.

SCRIBE SERVICE. A scribe dictates what should be written on the test paper.

- Use of a human scribe.
- Alternatives: use of word processor, spelling-checkers, grammar-checkers.

ORAL EXAMINATIONS. Unlike a written examination, oral examinations measure a student's ability to analyze, interpret, and respond to a question immediately. The additional time for thought that written exams provide, however, is sacrificed for the convenience of not having to use written words.

- Delineate the scope of the exam.
- Determine the format to be used in answering the exam questions.
- Determine the amount of detail that will be expected within a given time limit.
- The grading procedure and criteria should be spelled out in advance.

CALCULATORS. Make sure the use of a calculator is a matter of accommodation and not convenience when offering this option to students with disabilities.

ADAPTIVE EQUIPMENT. There are a number of options available for use in test accommodation. Examples are: a closed-circuit TV system for students with visual impairments, talking computers, talking calculators, and Braille printers. Students with disabilities may possess this type of equipment. Access to a closed-circuit TV system may be limited in many schools.

MODIFCATION OF TEST FORMAT. Modifications can be made in the following areas:

- Test format: essay, multiple-choice, true-false, fill-ins, etc.
- Size of the print.
- Size of the space allowed for response.
- Use of computer score sheets. For some students with disabilities, computer score sheets may be difficult or impossible to complete accurately and neatly. An accommodation for such students might involve having the student indicate the appropriate answer directly on the test paper and having a member of the staff transfer those answers to the computer score sheet when the student has completed the exam.

ENVIRONMENTAL CONTROL. Some students with disabilities cannot tolerate noises and distractions. They simply cannot concentrate on anything in a noisy environment.

- Students who are easily distracted may be allowed to bring sound-suppression earphones that block out extraneous noises.
- For students with disabilities who are aggravated by stress, provision of a private testing environment is an option.
- For students with disabilities who are on medication or whose energy level is fluctuating, the time of day for test administration is important. Consideration should be given time of test administration.

GRADING. When grading, not counting off for spelling errors, unless spelling is tested, is an option to take. Some students with disabilities experience great difficulty in spelling.

HEARING IMPAIRMENTS

- Students may be given written instructions or information ordinarily read aloud by the examiner.

- The oral or sign language interpreter may translate oral instruction and information.

VISUAL IMPAIRMENTS

- Arrange for a special edition of the examination, i.e., on tape, individually read, larger print, or braille.
- Students may use electronic optical aids, such as a Visual-tek, which enlarge the print; or non-optical aids, such as an Optacan or a Kurzweil Reading Machine which change the form of the print to be usable for students with visual impairments.

- Students may record answers by typing or taping.

- Students may dictate answers to a proctor who marks the answer sheet or writes an essay.

- Where spelling and punctuation are related to course objectives, the student and instructor may determine a way for grammar to be evaluated within the parameters of the adaptation.

PHYSICAL IMPAIRMENTS

- Program accessibility can be achieved through a variety of methods such as relocating classes to accessible facilities and offering services in alternate locations.

- Arrange for the examination to be given in an accessible building and classroom.

- Arrange for a proctor to assist for manipulation of test materials, marking examinations, and writing numbers and/or symbols as directed by the student.

- Arrange for alternative methods of recording answers such as typing and taping.

LEARNING DISABILITIES

Testing Room

- Allow students to take exams in a separate, quiet room with a proctor. Students are especially sensitive to distractions.

Time Extension

- Grant time extensions on examinations and written assignments when there are significant demands on reading and writing skills. Factors to be considered in determining a reasonable time extension include type of accommodation (Device? Personal aide? Other?), examination format (Short answer? Multiple choice? Open book? Essay? Paper?), experience of the student (prior education or onset of disability), and purpose of the course (personal development? Career preparation?).

- Avoid overly complicated language in exam questions, and clearly separate them in their spacing on the exam sheet. For those students who have difficulty in transferring answers, avoid using answer sheets, especially computer forms.

- Make a variety of test forms available well in advance of the test so that students can choose.

- Consider offering students a variety of ways to demonstrate their knowledge and skills.
- Consider substituting projects for examinations.
- Consider accepting alternative projects.
- Try not to test material just presented since more time is generally required to assimilate new knowledge. Give students a reasonable opportunity to learn and demonstrate their skills.
- In-class assignments may be completed outside of class.
- Permit the use of dictionary, computer spell checks, a proofreader or a calculator in science and math (if calculation is not tested). In math, students may understand the concept, but make errors by mis-aligning numbers or confusing arithmetical facts.
- When necessary, allow students to use a reader, scribe, word processor, tape recorder or typewriter.
- Critique early drafts of papers, providing pointers and encouragement for follow-up rewrites.
- Consider alternative or supplementary assignments that may serve evaluation purposes, such as taped interviews, slide presentations, photographic essays or hand-made models.

SCIENCE LABORATORY

It is important to learn from students with disabilities what has worked best for them in the past. Waiving lab assignment is not a solution, although some disabling conditions will clearly restrict the student's lab activities more than others. The level of involvement must be determined on an individual basis and be highly individualized. Although many technological devices of varying degrees of sophistication have been

developed, those materials and devices may not be readily available to teachers.

- An individual orientation to lab and equipment can minimize student anxiety.
- The labeling of equipment, tools and materials is helpful.
- The student's use of cue cards or labels or steps of a procedure may expedite the mastering of a sequence.
- Pair with other students as partners to complete the lab assignment.
- If students need extra time to complete the lab assignment, teachers should try to be flexible in making extra time available.
- Physical modifications in the lab may be necessary. Easy access is the goal. Providing more aisle space to permit movement is one example.

PART II. SPECIALIZED MATERIALS AND DEVICES FOR ACCOMMODATIONS

There exists a variety of specialized materials and devices designed for enhancing the functional ability of persons with disability. Although these materials and devices are not readily available for classroom use, certainly it would be helpful if teachers had some basic information about the products and their availability.

Certain modifications may be used across categories. Speech synthesis is the one that can be used by students with hearing impairments, students with visual impairments, students with physical impairments, and students with learning disabilities. Students who use speech synthesis can have the computer state what line the cursor is on and speak the words on that line, making almost all of the computer capabilities accessible to them. However, there are other materials and devices that are almost exclusively used by students who have specific types of disabilities.

Personal Computer Access Problems

The standard personal computer system can present barriers to students with disabilities. Some common access problems are found in the use of disk drive, keyboard, mouse, and monitor and screen. Therefore, modifications are often necessary to make the computer accessible to students with disabilities.

- Students with hearing impairments may need an alternative to the audible warning beep or error message. Although the screen display is accessible to students with hearing impairments, audible error messages or beeps must be converted to text so that they can be read

- Students with low vision may find it difficult reading a standard screen display. For these students, access to the computer requires one or more of the following modifications: speech, large print, or braille. The screen display is not accessible to persons who are blind. Students who are blind usually need speech, braille, or a combination of the two.

- Those who have physical disabilities may find it difficult to insert the diskette, or turn on the power switch, or use the mouse, or keyboard. These students may need alternative input devices such as switches, modified keyboards, joysticks, and software (utilities) depending on their best remaining function.

Solutions

Generally, there are two ways that students with disabilities can use a microcomputer: one way is to develop special software to run on standard computers and the other way is to modify the computer itself to run any software. Adapting or modifying the computer is called 'transparent access.' Products currently developed use two different approaches to transparent access: one approach is modifying operating system software and the other approach is modifying computer hardware to allow students with disabilities to use standard software. Since the operating system coordinates the computer's input and output, it can be modified to accommodate special adaptations. For example, changes can be made in the operating system so that the output sent to the screen will also be sent to a speech synthesizer or braille display.

There are two major types of hardware modifications: one type is simple modifications to the keyboard (such as keyguards and key latches), disk drives (such as disk loading trays), or computer screen (such as enlarging lenses being installed in front of the screen), and the other type is connecting special alternative keyboards (such as, optical lightbeam, expanded keyboards, speech recognition), disk drives, or alternative displays (such as enlarged images, voice output, braille display, screen reading programs and speech synthesizers).

A. ADAPTIVE MATERIALS AND DEVICES BEING USED ESPECIALLY BY STUDENTS WITH HEARING IMPAIRMENTS

Hearing Aid

Hearing aids help students with hearing impairments by amplifying sound. However, in many situations, students with hearing impairments, even with an appropriate hearing aid, may have difficulty in understanding speech due to competing background noise.

Hardwire, Loop, Infrared, and FM

Amplification systems are available to overcome the negative effects of noise, distance and echo and improve hearing ability in large areas such as lecture and concert halls and in interpersonal communication situations such as small group discussions and television viewing. These systems—hardwire, loop, infrared and FM-- deliver the desired signal, such as a speaker's voice, directly to the ears or hearing aids of the listener.

B. ADAPTIVE MATERIALS AND DEVICES BEING USED ESPECIALLY BY STUDENTS WITH VISUAL IMPAIRMENTS

The assistive technology available to students who are partially sighted or students who are blind is extensive. The cause of visual loss, the extent of loss of visual acuity, the quality of peripheral vision, and any other accompanying disabilities are important factors in determining appropriate devices to be used.

STUDENTS WHO ARE PARTIALLY SIGHTED

- Many students with visual impairments use adapted versions of the texts used in their classes. The three major types of adapted versions of the

texts are enlarged books and books produced on microcomputer disks. Enlarged books are heavy and bulky. Books on disks can be viewed on a computer screen. The size of the type can be adjusted. (Any page of the book can be printed out on paper and in braille. Instant voice-to-print and print-to-voice translations of documents are possible.)

- The print in standard text can be enlarged on a closed-circuit television. Such modifications are essential for most students with glaucoma, congenital cataracts, or nystagmus. However, for students with good central vision but a limited visual field, enlargements may be a hindrance. For those students, audiocassette versions of textbooks may be a better choice.

Screen Enlarger Utilities. Screen enlarger utilities (large print programs) enable students with visual impairments to enlarge the text and graphics on the computer screen.

Large Print Display. With special equipment and software, computer-generated text and graphics can be enlarged on the monitor or printer for persons with visual impairments. Special software can change or adjust color of the monitor, or reverse the screen from black on white to white on black for persons who are light sensitive. Anti-glare screens can make screens easier to read. Here are some examples:

- **Closed Circuit Television** (Telesensory Systems, Inc., 415-960-0920) magnifies a computer document onto a screen for easy reading by persons with visual impairments.

- **VISTA VGA** (Telesensory Systems, Inc., 415-960-0920) and **MAGic Deluxe** (Microsystems Software, 800-828-2600) display enlarged print on an IBM-compatible screen. Screen Magnifier/2 (IBM Special Needs Systems, 800-426-4832) provides enlargement for the OS/2 operating system.

- **InLarge** (Berkeley System Design, 510-540-5535) software enlarges the screen output while running most software available for the Macintosh.

Features include a reverse screen utility, crosshairs to easily find the mouse pointer and a modifiable area of magnification.

- **Close View** (Apple Computer, Inc., 800-776-2333) also enlarges screen output on the Macintosh computer.

- **MagniPORT** (Microsystems Software, Inc., 800-828-2600). Pop-up screen magnification window that tracks mouse movements and magnifies up to 10x. Supports all displays and display resolutions.

STUDENTS WHO ARE BLIND

Students who cannot use visual information will use the computer with the aid of a screen review utility. Screen reader utilities take the information displayed visually on the screen and make it available through alternative media, such as synthesized speech or a refreshable (paperless) braille display. Some examples are:

- **JAWS for Windows** (Henter-Joyce, Inc ., 800-336-5658). A flexible, Window-based screen reader. It also includes JAMAL macro language.

- **outSPOKEN for Windows** (Berkeley Systems, Inc., 510-540-5535). This supports over 30 speech synthesizers and works with a variety of screen review packages for MS-DOS and Windows 3.1x.

- **Virgo** (Telesensory Corp., 800-227-8418). Virgo and it's sister product Screen Power for Windows were created to provide braille access to Windows.

- **WINDTS** (F.H. Papermeier GmbH & Co. KG Reha Division, Germany, +49-2304-8970). This is a software package that allows blind persons to access programs running under the Windows graphical user interface with Braille, using the BRAILLEX-2D Screen Braille display.

- **WINKLiNE** (Speech Systems for the Blind, 800-865-3624). This program provides text-to-speech within the Windows environment using any multimedia sound card supported by Windows. It identifies icons,

menus, and controls, as well as echoing words as they are typed or when they are written to the screen.

Braille Word Processing. Special braille printers interface with computers to take advantage of the word processing capabilities. Conversion of text to braille, and braille to text is possible. The text can be displayed on the computer screen or printed hard copy braille. Refreshable (paperless) braille is also available. Some examples are:

- **Index Braille Embosser** (Index Advanced) prints IBM-compatible computer output in braille. **Duxbury** (Duxbury Systems, Inc., 508-486-9766) allows the computer to translate text into braille format and send it to the Braille embosser.

- **Navigator Refreshable Braille Display** (Telesensory Systems, Inc., 415-960-0920) provides a tactile Braille display of the IBM-compatible computer screen, allowing the user to read what is on the screen 40 characters at a time

Tactile Forms. For those who cannot read any print regardless of size, there are various devices that convert printed letters to a tactile code of vibrating patterns or to braille.

Computerized Letter Recognition. Speech synthesizers and text-to-speech programs can convert words stored in the computer to speech, large letter displays, braille, or to tactile signals.

Scanners with optical character recognition can read printed material and store it electronically on computers. These data can be read using voice synthesizers or printed with braille translation software and Braille printer.

C. ADAPTIVE MATERIALS AND DEVICES BEING USED ESPECIALLY BY STUDENTS WITH PHYSICAL DISABILITIES

On-Screen Keyboard Utilities. This is a program for those who cannot use a standard keyboard but can use one or more switches, a point-and-click, point-and-dwell, or simple clicking interface using a mouse or a headpointer. A common use of this technique is to display a picture of a keyboard and allow the user to choose keys which will be typed into the current application. Variations in this category include Morse-code input systems and single- or double-switch systems. Here are some examples:

- **Eek!** (OMS Development, 800-831-0272). This is an on-screen keyboard for Windows that can be used in click mode.

- **GUS! Talking Keyboard for Windows GUS!** (Communications, 604-224-6699). It combines an on-screen keyboard for typing into a large-print editing window, accompanied by digitized and synthesized speech. It works with any multimedia sound card.

- **HandiKEY For Windows** (Microsystems Software, Inc., 800-828-2600). This is an on-screen keyboard for Windows which also includes word prediction, sticky keys and speech output.

- **Mouse Keys** (World Communications, 510-656-0911). This is an on-screen keyboard for Windows which also includes word prediction. It supports French, German, Spanish, and Italian.

Voice Input Utilities. With voice input utilities, the computer can perform certain tasks by recognized spoken commands. Some products also support dictation that allows the user to enter large amounts of free-form text such as a letter. Most products recognize discrete speech but some products support continuous speech. Speech recognition (dictation) systems allow the user to dictate text into the computer by voice. A particular system is trained to recognize specific voices. Some voice systems include dictionaries, up to 120,000 words. Without having to use the keyboard, the user can dictate a fully corrected document at up to 70 words per minute.

Voice also controls computer commands such as "save, cut, paste and print." These systems can also provide a method to create custom text macros that can enter large blocks of text with a single command resulting in greater efficiency. Here are some examples:

- **IN CUBE PRO Voice Command for Windows** (Command Corp., Inc., 404-813-8030). This is a continuous speech-recognition system which can be used without modification by persons with disabilities for command-and-control of Windows-based applications.

- **IBM Continuous Speech System** (IBM, 800-342-6672). This is a command-and-control utility supporting up to 1000 vocabularies. Available in six languages.

- **IBM VoiceType Dictation for Windows** (IBM, 800-342-6672). This is a large-vocabulary system supporting up to 32,000 words at a rate of 70-100 words per minute with 97 percent accuracy.

- **VoiceUser** (Cylogic, 206-283-8800). This is a speaker independent command and control interface for Windows-based applications. Pre-configured vocabularies and macros allow virtually anyone to start the program with little or no voice training.

- **DragonDictate for Windws** (Dragon System, Inc., 617-965-5200). This is a large-vocabulary dictation system which is designed for completely hands-free use. **Dragon Dictate 30K** provides voice control of an IBM-compatible computer using a microphone headset. Word processing can be done without using a keyboard.

- **Kurzweil VOICE for Windows** (Kurzweil Applied Intelligence, Inc., 800-380-1234). This is a large vocabulary, speaker-independent voice recognition system for Windows. It supports voice input for dictation.

- **Windows Sound System** (Microsoft Corp., 800-624-9400). It includes a feature called Voice Pilot which allows small-vocabulary command and control.

Keyboard Enhancement Utilities. Keyboard enhancement utilities are products which modify the behavior of the Windows keyboard to make it easier to use for persons with disabilities. Some examples are:

- **Access Packs for Microsoft Windows** and **Microsoft Windows NT** (Microsoft Corp., 800-426-9400). This provides a variety of features for persons with limited dexterity or who are deaf or hard-of-hearing: allowing single-finger typing of SHIFT, CTRL, and ALT key combinations; ignoring accidental keystrokes, and adjusting the rate at which a character is repeated when a key is held down.

- **Dvorak Keyboard Layouts** (Microsoft Corp., 800-426-9400). This is for those who have difficulty using the standard iQWERTYi. There are three types of layouts: (1) for those who use two-hands; (2) for those who use left hand only; (3) for those who use right hand only.

- **HandiWORD and HandiWORD** Deluxe for Windows (Microsystems Software, Inc., 800-828-2600). This program is for keyboard rate enhancement via word prediction and abbreviation expansion for Windows. Sticky-key utility is built into the software. Version 3.01.0 supports speech output of word choices and Deluxe version supports foreign languages.

Keyboard Modifications. Examples of low-tech keyboard modifications are:

- **Highlighters** such as stickers, keycaps, labels to highlight important keys,

- **Keyguards** (plastic overlays with finger-sized holes that are placed over a keyboard to prevent accidental key pressing), and

- **Masks** (cardboard masks being placed over keyguards to show only the keys that work individual software programs).

Examples of system utilities. **AccessDOS** is a software program developed by the Trace Research and Development Center, University of Wisconsin-Madison (608-262-6966) with support from IBM. It provides extended keyboard, mouse, and sound access for IBM DOS user's. It is especially helpful for those with disabilities. Some key features are:

- StickyKeys. Allows the user to execute multiple key operation (such as SHIFT, CTRL, ALT) with a single finger or stick.

- MouseKeys. Provides a way for users who cannot handle the mouse but who can press keys on the keyboard, to perform all the functions of the mouse. The keys on the numeric keypad are used to control all of the mouse functions.

- RepeatKeys. Allows the user to adjust how fast the auto-repeat works, or to turn it off and eliminate the repeat function.

- SlowKeys. Instructs the computer not to accept a key as 'pressed' until it has been held down for a specific length of time.

- BounceKeys. Prevents double characters from being typed if the user bounces on the key when pressing or releasing it.

- ShowSounds. Blinks the screen or displays a small musical note in the upper left-hand corner of the display when the computer makes a sound (for persons who are deaf or hard of hearing).

- SerialKeys. Allows the user to control the keyboard and mouse functions from an external assistive device (such as communication aid) connected to the computer's serial port.

- ToggleKeys. Produces a 'beep' to indicate when the Caps Lock, Num Lock, or Scroll Lock keys are activated.

Also available is Access Pack for Windows 3.0/3.1 from Trace Research and Development Center.

Keyboard Alternatives. When the standard keyboard does not meet the needs of the user, alternatives can be found. Examples are Plug and Play (keyboards which replace the standard), ergonomic (which provides additional supports), compact/reduced keyboards, and enlarged keyboards. Large Print Keytop Labels (Hooleon Corp., 800-937-1337) double the size of standard keyboard labels to help persons with visual impairments locate keys.

Most individuals who are blind can use standard keyboards; however, braille input devices are available. Braille key labels assist with keyboard use.

Keyboard Layouts. Examples are Standard (QWERTY), Alphabetical Order, and Dvorak (for left hand and right hand). Standard input methods include standard keyboard, mouse, joystick, and light pen. Adaptive input methods include touchscreen, expanded and mini-keyboards, macros, Morse code, single or dual switch use, and communication aids.

- **Dvorak Keyboards.** The keyboard is arranged in such a way that the most commonly used letters and keys are within close proximity of the home row. This arrangement decreases hand and finger movements and utilizes the stronger fingers to type the keys most often used. Separate Dvorak keyboards (Dvorak One-handed Left keyboard from Typing Institute for the Handicapped, 602-939-5344) are also configured for one hand typists.

- **Comfort KeyBoard**. The standard keyboard is split into three sections, each of which tilts and rotates to any position.

- **Mini Keyboard** (TASH, Inc., 905-686-4129): This small keyboard for an IBM-compatible personal computer allows full keyboard access to individuals with limited range of motion, and limited strength. Very little force is required to activate the keys and it can be activated with mouthstick or finger.

- **Expanded Keyboard** (EKEG Electronics Co., 604-273-4358). Expanded keyboard, a large keyboard (14"x24"), spaced far apart, that can be used on an IBM-compatible computer, is designed for persons with limited fine motor control. The keyboard is fabricated with a matrix of touch-sensitive switches beneath their membrane surface, that can be plugged directly or indirectly (with a special interface) into the keyboard port of a computer. The small individual squares can be grouped together to form larger keys to assist persons with disabilities who need larger key areas to focus on using the software. Only light pressure is required to activate the 11/2" square keys.

- **Keyguard** (IBM version from TASH, Inc., 905-686-4129; Macintosh model from TechAble, 404-922-6768), is a template with a hole over each key of a standard keyboard to assist persons who have limited fine motor control in accurately selecting keys. With the keyboard guard, the key repeat function can be disabled in such a way that those who cannot release a key quickly enough can avoid multiple selections.

- **Onscreen Keyboards.** Onscreen keyboards are used with head pointing systems--head movements control the pointer, a receiver translates head movements, and the item is clicked with a switch. Onscreen keyboards focus at a single location, can be moved and re-sized, and can incorporate other features.

Switch Scanning System. In scanning input, lights or cursors scan letters and symbols displayed on computer screens or external devices. Persons who have severe mobility impairments can activate the switches with head, finger, foot, breath, etc. ScreenDoors (Madenta Communications, 800-661-8406) software puts an image of the keyboard on the screen. Typing is done by moving the cursor to the character on the keyboard image with the headset and puffing on the mouthswitch.

Mouse Modifications. Examples of mouse alternatives are Track balls and TouchScreens. A Track Ball (Kensington, Inc., 800-535-4242) is a pointer alternative that replaces the mouse on the Macintosh or IBM-compatible computer. Persons with fine motor control and/or range of motion limitations find a track ball easier to use than a standard mouse.

D. ADAPTIVE MATERIALS AND DEVICES BEING USED ESPECIALLY BY STUDENTS WITH LEARNING DISABILITIES

Some students with learning disabilities find adaptive devices useful—such as large print display, alternative colors on the computer screen, and voice output—even though they were originally designed for those who were visually impaired useful.

Special Software Features. Word processing features usually include talking text programs, enlarged text, rebus writing, sound effects, and spell/grammar checkers. A standard word processor can be a valuable tool for persons with dysgraphia (an inability to produce handwritten materials legibly). Inspiration (503-245-9011) is a brainstorming and writing tool that allows ideas and text to be represented graphically and converted to outline format. This is good for students with learning disabilities to organize information.

- **WordScholar** (Henter-Joyce, Inc.). This is an educational software package for persons with learning disabilities. This software supports a variety of synthesizers such as DECtalk PC and sound cards like Sound Blaster. The software highlights and speaks by character, word, line, sentence, paragraph or full screen. It also works well with popular text based DOS applications like WordPerfect and Professional Write (Adaptive Solutions catalog).

- **Type'nTalk** (Lorien Systems). This is a utility program that can be used with any Windows program in IBM compatible computers. It can speak on each letter as it is typed, speak on each word as it is completed, and speak each sentence as it is completed. Pieces of selected text can be spoken. The pitch, speed and volume of the voice are customizable. It can convert word processors into a talking version. Foreign language support is available.

Word Prediction Software. Word prediction software can reduce input demands for commonly-used text and keyboard commands. Word prediction software programs are designed to reduce the number of keystrokes persons with mobility impairments must make by predicting what will be selected next. For example, word prediction software anticipates entire words after several keystrokes. A window appears on the screen with word choices available; these choices are stored in a dictionary which is modified to meet the users needs. Word prediction software increases input speed. This program is also good for students with learning disabilities.

- **Co:Writer** (Don Johnston, Inc., 800-999-4660) and **Screen Doors** (Madenta Communications, 800-661-8406) are word prediction software packages that operate on a Macintosh computer. **HandiWORD** (Microsystems Software, 800-828-2600) provides word prediction on an IBM-compatible computer.

- **Vocal Eyes** (GW Micro, 219-483-3625) and **JAWS** (Henter-Joyce, Inc., 800-336-5658) screen reading software for the PC provide an interface to DOS-based applications for persons with blindness and visual impairments.

Keyboard Macro (abbreviation expansion) Software. Keyboard macro programs are designed to reduce the number of keystrokes needed and/or reduce the complexity of using a computer program by allowing the user to combine sequences of keystrokes together onto one or two user-selected keys.

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